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# Available Power of Arduino Mega 2560 without Recourse to extern Supply

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**Abstract.** The microcontroller family Arduino is getting more popular nowadays because of its practical handling and integrity to other systems. During conducting an experiment of controlling a humanoid robot of the type Robotis Bioloid not with its original microcontroller but with an Arduino Mega 2560 instead the power limits of it were found.

**Keywords:** Arduino Mega 2560, Power Limitation, Current Supply

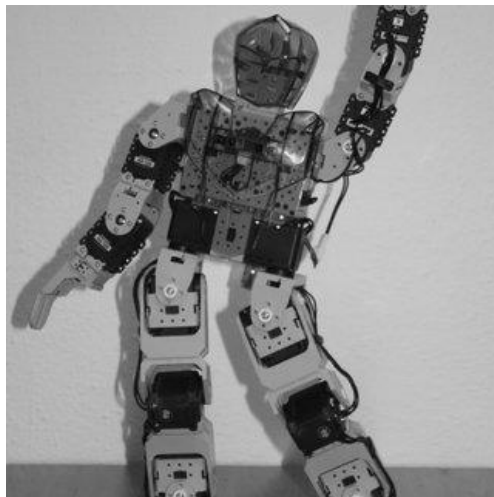
## 1

### Introduction

A humanoid robot is a robot with its overall appearance based on that of the human body. Perception, processing and action are embodied in a recognizably anthropomorphic form in order to emulate some subset of the physical, cognitive and social dimensions of the human body and experience. In general humanoid robots have a torso with a head, two arms and two legs, although some forms of humanoid robots may model only part of the body, for example, from the waist up. Some humanoid robots may also have a 'face', with 'eyes' and 'mouth'. The definition of a humanoid is as simple as "having human characteristics."

There are a multiple of companies producing humanoid robots for educational or entertainment purposes. Robotis is one of them. We worked mainly with Bioloid Comprehensive type of robot of them during this paper.

Each humanoid robot has its microcontroller unit to be able to manipulate the servos and manage other stuff. The main goal was to control the robot with a common open source microcontroller which could be get for a reasonable price. The decision was an Arduino Mega 2560.



**Fig. 1.** Robotis Bioloid kit (Source: Robotis, 2022)

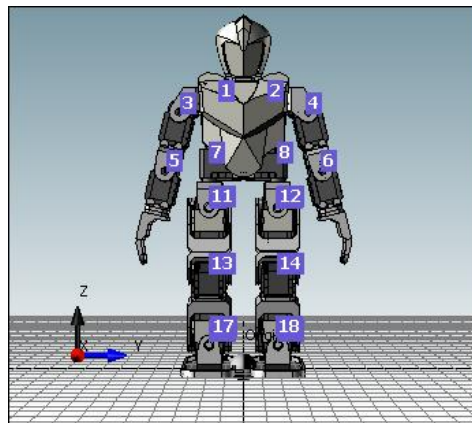


**Fig. 2.** Arduino Mega 2560 microcontroller (Source:<https://www.arduino.cc/en/uploads/Main/ArduinoMega.jpg> )

## 2

## Tests

Our humanoid robot has 18 servo motors in total. Each servo is able to be moved independently in a given range. So starting our experiments every servo was able to be moved individually with the help of the Arduino controller.



**Fig. 3.** All DOFs of our robot (Source: Robotis, 2022)

The servo motors used are of the type Dynamixel AX-12 which can also be purchased separately to fulfill common tasks. The data sheet of it is available in Table 1.

**Table 1.** Specifications of Dynamixel AX-12 servo motors .

Model Name		AX-12A
MCU		-
Input Voltage	Min. [V]	9.0
	Recommended [V]	11.1
	Max. [V]	12.0
	Voltage [V]	12.0
Performance Characteristics	Stall Torque [N·m]	1.50
	Stall Current [A]	1.5

<b>Continuous Operation</b>	<b>No Load Speed [rpm]</b>	59.0
	<b>No Load Current [A]</b>	0.14
	<b>Voltage [V]</b>	-
	<b>Torque [N·m]</b>	-
	<b>Speed [rpm]</b>	-
<b>Resolution</b>	<b>Current [A]</b>	-
	<b>Resolution [deg/pulse]</b>	0.2930
	<b>Step [pulse/rev]</b>	1
<b>Position Sensor</b>	<b>Angle [degree]</b>	300
		Potentiometer
<b>Operating Temperature</b>	<b>Min. [°C]</b>	-5
	<b>Max. [°C]</b>	70
<b>Motor</b>		Cored
<b>Baud Rate</b>	<b>Min. [bps]</b>	7,843
	<b>Max. [bps]</b>	1,000,000
<b>Control Algorithm</b>		Compliance
<b>Gear Type</b>		Spur
<b>Gear Material</b>		Engineering Plastic
<b>Case Material</b>		Engineering Plastic
<b>Dimensions (WxHxD) [mm]</b>		32 X 50 X 40
<b>Dimensions (WxHxD) [inch]</b>		1.26 X 1.97 X 1.57
<b>Weight [g]</b>		55.00
<b>Weight [oz]</b>		1.93
<b>Gear Ratio</b>		254 : 1
<b>Command Signal</b>		Digital Packet
<b>Protocol Type</b>		Half duplex Asynchronous Serial Communication (8bit, 1stop, No Parity)
<b>Link (Physical)</b>		TTL Level Multi Drop Bus
<b>ID</b>		0 ~ 253
<b>Feedback</b>		Position, Temperature, Load, Input Voltage, etc
<b>Protocol Type</b>		Protocol 1.0
<b>Operating Mode / Angle</b>		Wheel Mode: Endless turn
		Joint Mode: 300 [deg]
<b>Output [W]</b>		-
<b>Standby Current [mA]</b>		50

After the first tries of controlling the servos the goal was to move the servos in sequence, so a human like behaviour would be imitated . Moving one and also two servos worked without difficulties but at the same time it was noticed that

the power supply part of Arduino board was overheated. When a third servo was added to the sequence the robot began not to react at all first and trying it several times the code could not be loaded from computer to the Arduino board anymore. Looking for the reason it was realized that the bootloader of the microcontroller could be burnt. A second and also third new Arduino microcontroller board were damaged in the same way. So there should be some incompatibilities between the robot and the microcontroller. A very decent idea was also that the Arduino board can not provide enough current to supply the servos. The Dynamixel AX-12A servos of the robot need a current of 1,5A at a voltage of 12V which results in a needed power of 18W. Obviously this could not be delivered by our Arduino controller.

### **3 Summary and Outlook**

The microcontrollers of Arduino face increasing popularity all over the world. The tests done showed us that an external current source seems to be more rational to use if one needs more than, in our case, 2x18 Watt of power. The controller itself can only deliver small currents which yields small total powers.

### **References (in Basic)**

1. Arduino website : <https://www.arduino.cc/en/uploads/Main/ArduinoMega.jpg>
2. Robotis website: [BIOLOID Premium Advanced Educational Robot Kit \(robotis.us\)](https://www.robotis.us/bioloid-premium-advanced-educational-robot-kit/)
3. Robotis website: <https://www.robotis.us/dynamixel-ax-12a/>